State of California
Department of Fish and Game

Memorandum

Date: 7/7/09

To: Richard Muhl
California Regional Water Quality Control Board
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From: Carol Oz, Staff Environmental Scientist
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Carol Oz

Subject: Sediment Pollution in Jackson Creek, Amador County

On 6/2/09 I received information from you regarding a storm water release from a construction site (Del Rapini Construction, Inc.) near Hwy 88 and Ridge Rd. in Amador County, which resulted in a turbid water discharge to Jackson Creek. The discharge occurred for approximately 24 hours on and around 2/17/09. I reviewed the information you provided in the 2/17/09 "Storm Water Construction General Permit Inspection Report" (Report) including photographs and water monitoring results collected during the incident. This memo includes my evaluation of the information you provided and my conclusions regarding deleterious impact to natural resources caused by anthropogenic turbidity in the stream.

Per the Report, turbidity measured at the discharge construction site outfall to Jackson Creek was 979 Nephelometric Turbidity Units (NTU); background measurement of turbidity in the creek upstream of the discharge location was 30 NTU. A photograph (Figure 3) in the Report shows two water samples collected at the site. The sample collected from the construction site outfall in Jackson Creek was opaque brown in color, the same color as water on the construction site, while the Jackson Creek background water sample (Figure 2) was clear. Photographs show similar opaque brown sediment-laden stormwater on the construction site and flowing off the site into the clear waters of Jackson Creek (Figures 1-4).

DELETERIOUS EFFECT OF TURBIDITY ON AQUATIC LIFE

Turbidity is a condition of water resulting from the presence of suspended particles (Welch 1952), such as clay, silt, finely divided organic matter, bacteria, plankton, and other microscopic organisms. As an expression of the optical property of water, which causes light to be scattered and absorbed rather than transmitted in straight lines through the sample, turbidity is commonly measured optically with the use of a special light meter. Data is commonly reported in NTUs. It is natural to find silt and sediment in water but problems result when excess amounts are introduced into the water. Excess

amounts can harmfully affect water quality, an essential component of fish habitat. Excessive turbidity is deleterious to fish and aquatic resources in several ways. The most obvious effect is that it reduces light penetration into the water and, therefore, reduces photosynthesis by phytoplankton organisms, attached algae, and submersed vegetation which are essential for food chain development and support. Additionally, excessive turbidity may inhibit normal feeding behavior for sight feeders, such as trout and other freshwater species of fish and nanoplankton.

Excessive turbidity can cause gill irritation, increase mucous secretion, and respiratory and physiologic distress. Death of fish and aquatic invertebrates exposed to "inert" particulates, which cause increased turbidity, is not usually the result of classic toxic response, but rather the effect of physical abrasion, gill clogging and ultimately suffocation. Natural weathered sediments tend to clog spaces between sensitive gill tissue, while un-weathered mineral solids, coat the actual gill filaments, and thus impede water contact and proper gas exchange, resulting in asphyxiation (Sherk, 1971). Exposure to suspended particles can also dislodge insects and algal populations sufficiently to inhibit primary and secondary productivity to the detriment of the stream's carrying capacity (Iwamoto, 1978, Gammon, 1970).

Buck (1956) investigated several farm ponds, hatchery ponds, and reservoirs over a 2-year period in which he measured fish production. He observed that the maximum production of 161.7 lb/acre occurred in farm ponds when the average turbidity was less than 25 NTU; between 25 and 100 NTU fish yield dropped 41.7 percent to 94 lb/acre, and in muddy ponds, where turbidity exceeded 100 NTU, the yield was only 29.3 lb/acre or 18.2 percent of clear ponds.

Exposure to suspended particles can also dislodge insects and algal populations sufficiently to inhibit primary and secondary productivity to the detriment of the stream's carrying capacity (Iwamoto, 1978, Gammon, 1970). While a sand or mud bottom may provide limited habitat for burrowing invertebrates, burrowers are not as available to salmonids as are the preferred forms such as mayflies, caddisflies, and stoneflies that normally inhabit clean, gravel habitat.

Among the biological effects due to suspended sediments are shading, abrasion, smothering, and reduced feeding due to increased turbidity (Berry, et al, 2003). Suspended sediment can be abrasive and may damage the fine gills and mouthparts of macroinvertebrates. It may also make it harder for predatory macroinvertebrates to see their food. Macroinvertebrates that feed on algae may have to spend more time feeding because fine sediment sticks to the algae, reducing nutritional value. Increased sedimentation can disrupt the food web by influencing the distribution and abundance of fish, macroinvertebrates, plants and algae (Till and Trayler, 2000).

Suspended particulates also add significantly to the amount of solar radiation which is absorbed by the water, and thus increases water temperature to the detriment of oxygen dynamics, and fish respiration. Finally, when suspended particles settle the resulting sedimentation is detrimental to benthic and other aquatic life (EPA 1986).

Modification of streambed habitat by deposition of fine sand, silt, or clay-sized particles poses one of the most serious threats to the survival of many salmon and trout species (Tarzwell and Gaufin, 1953; McNeil and Ahnell, 1964). The streambed is the incubator for developing eggs; it provides vital cover or refuge for developing fry, and provides habitat for the bulk of the food organisms required by young salmon, trout, and other fish for survival (Crouse et al, 1981, Phillips, 1971, Wolf, 1950). The success of this

interdependent relationship is directly related to the presence of "clean", suitably-sized streambed materials (McNeil and Ahnell, 1964).

The mainstay of the diet of salmonid fishes, such as trout, is composed of insects such as stoneflies, mayflies and caddisflies. These insects develop on the clean surfaces of large gravels and cobbles, and depend to a large degree on turbulent water around these rocky surfaces to bring them food. The deposition of sands, silts, or clays, around and on top of streambed rubble, reduces the area upon which aquatic insects develop (Phillips, 1971), reducing the feed available for downstream salmonids. Other aquatic species can be equally and adversely affected by the deposition of fine particulates. Salamanders, amphibians, and a host of insect species can become physically entrapped, along with fish fry and incubating eggs, beneath cemented (fine sediments settle into gravel and tend to cement the gravel together) gravels and rocks (Branson and Batch, 1972).

RESOURCES AT RISK

Jackson Creek originates in Amador County and flows through the city of Jackson to Lake Amador west of Hwy 49. From Lake Amador the creek flows into Dry Creek, thence the Mokelumne River. Beneficial uses of this creek include warm freshwater aquatic habitat, cold freshwater aquatic habitat, warm and cold fish migration habitat, warm spawning habitat, and wildlife habitat. Species found in this water system include Pike minnow, Green sunfish, Brown trout, Rainbow trout, Pacific chorus frog, Bullfrog, Crayfish, Garter snake, River otter, and benthic macroinvertebrates. Sensitive species found in the creek ecosystem include state Species of Special Concern: Foothill yellow-legged frog *(Rana boylii)*, Western Pond turtle (*Clemmys marmorata)*. Habitat exists downstream of Hwy 49 that would support the Federally Threatened California red-legged frog *(Rana aurora draytonii)*.

CONCLUSIONS

It is my opinion that the discharge of silt and sediment to this stream was deleterious to aquatic life in Jackson Creek. The turbidity measurement of the construction site discharge water in the creek was almost 33 times higher than the normal background water turbidity. Cloudiness and turbidity of waters that would otherwise have been clear would have deleterious impacts on fish and aquatic macroinvertebrates such as clogging and abrasion of the gills, behavioral changes in fish, including movement and migration; decreased resistance to disease; impairment of feeding; poor egg and fry development, and; fatal impacts to small aquatic animals that are food for fish. Prior to this pollution incident, the stream would have provided habitat for benthic macroinvertebrates. Turbidity and potential deposition of sediment in the stream at and below the construction site likely displaced macroinvertebrates and would result in a shift in the aquatic community, changing the benthic macroinvertebrate composition to fewer sediment intolerant mayfly, caddisfly, and stonefly species. Reduction in macroinvertebrate abundance and diversity reduce food supply for downstream fish species such as trout.

Please contact me at (916) 358-2918 if you have any questions.

cc: Kent Smith-DFG Habitat Conservation Program Manager

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